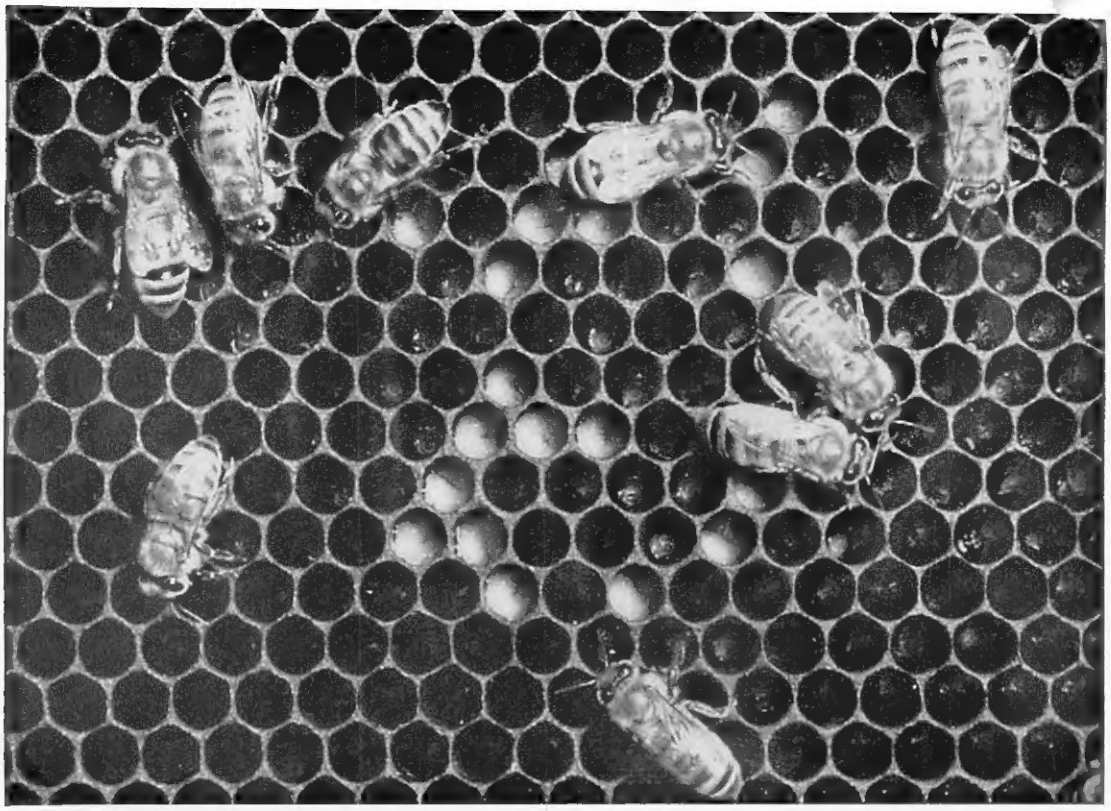
# BEE

Stages in the life cycle of the honeybee. *Left to right:* (1) Egg, (2) young larva, (3) mature larva, (4) a white pupa showing the sheaths of adult legs and antennae and darkening of the eyes; (5) a pupa in which the adult has become fully colored and is ready to emerge; and (6) an adult worker with fully-formed wings.

Color photographs by Charles E. Palm. From "American Social Insects," by Charles D. Michener and Mary H. Michener. 

The three castes of the honeybee. *Left to right:* (1) Worker, (2) drone or male, and (3) queen. Note that the queen is long but has a slender body. The drone is more robust, and he has very large eyes. The worker is the smallest of the three, and proverbially the busiest. The bees which we ordinarily see are all workers.



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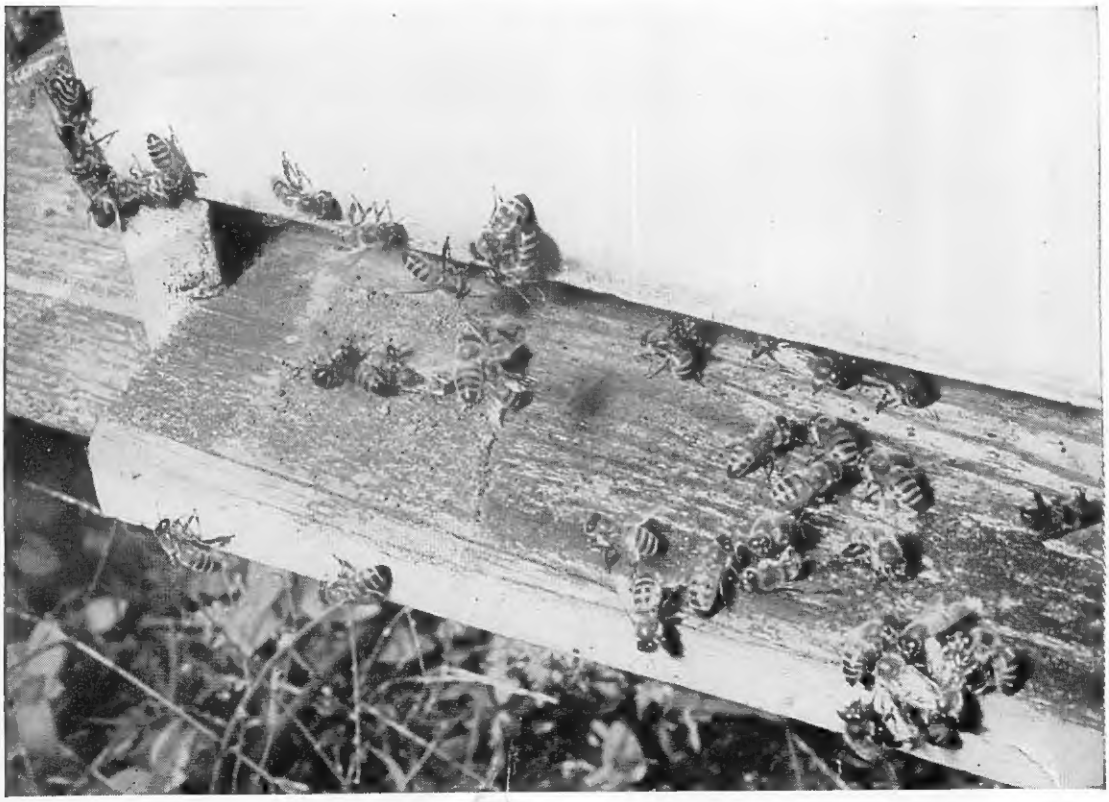
White larvae of the honeybee, in various stages of growth, are shown here inside the cells of the comb structure. They are still legless and must be supplied with food by the adults.



Below, worker bees drag ailing drones and weckling or disabled workers out of the hive. One of the workers' many responsibilities is to maintain the productive efficiency of their caste.



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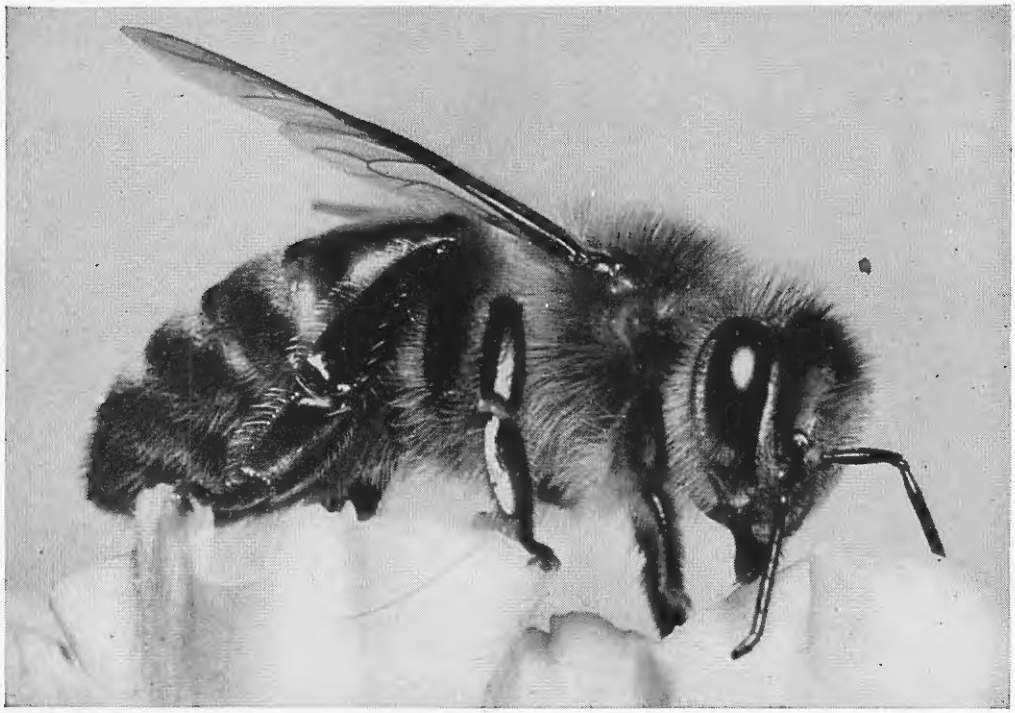

When gathering pollen, a bee almost unfailingly goes to flowers of the same species. Seldom is more than one species of plant visited by an individual bee on any one trip.



*Lower left:* The drone or male bee has no sting and does no work besides mating with a new queen, whereupon he dies. *Lower right:* Worker guards are stationed at each entrance to the hive to chase away bees from other hives coming to steal honey. This guard personnel is constantly changing but always on the alert.

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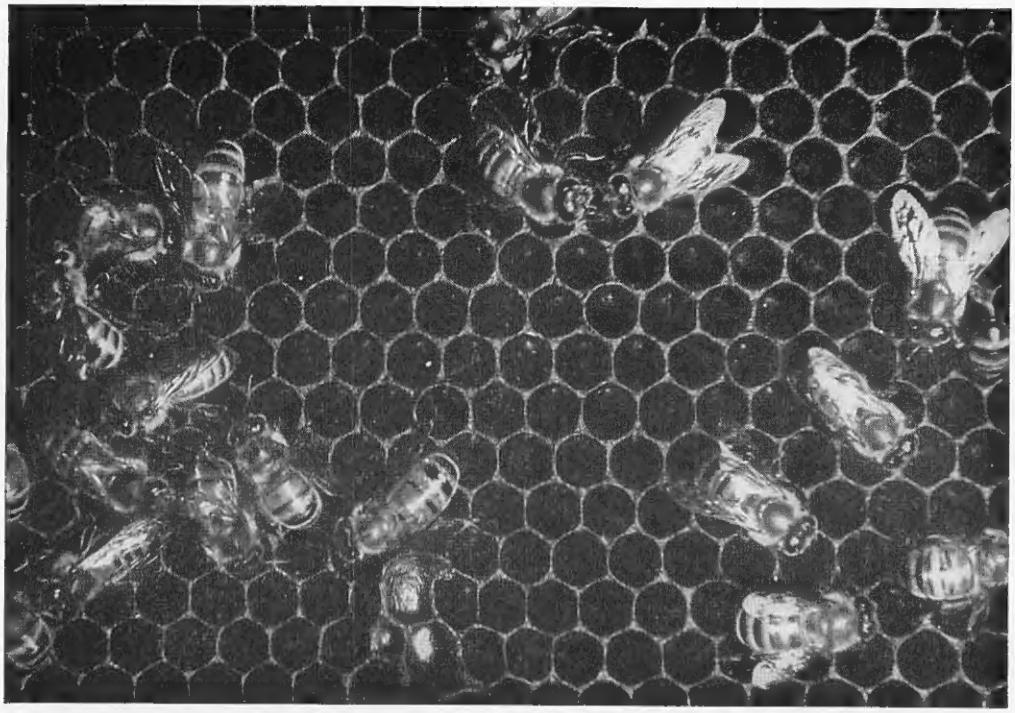
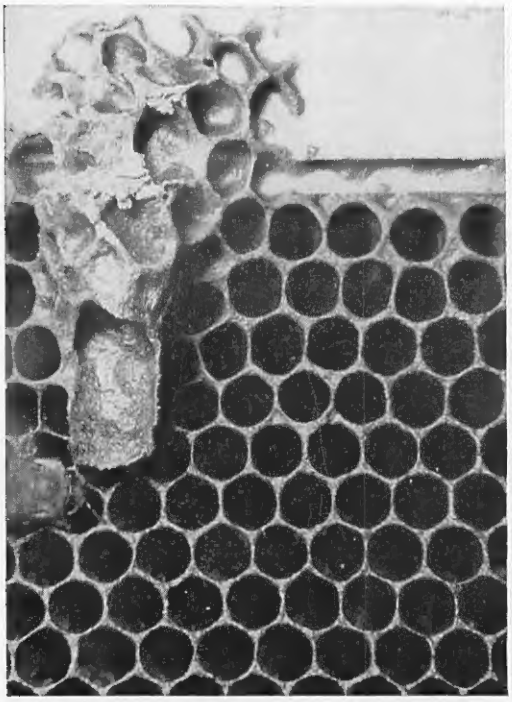
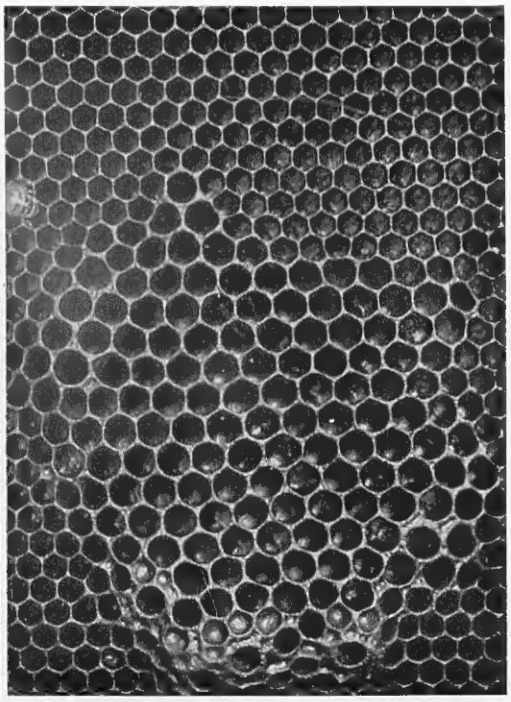


Workers feeding on the honey they have stored in the cells. The workers live only about six weeks in the warm season, possibly several months in the winter cluster.



*Lower left:* The queen, or fertile female, is longer and larger than the workers. The cell containing an egg designated to become a queen is large and irregularly shaped and stretches over the face of the comb. *Lower right:* Drone cells are larger than the surrounding cells built to house worker larvae.





that had conspicuous entrances. There is even a genus of bumblebees, *Psithyrus,* that, like the inquiline bees discussed in a previous paragraph, is dependent on a host species for the rearing of its young. In the case of *Psithyrus* the host species is always a bumblebee. *Psithyrus* has no worker caste and it is the workers of the usurped colony that rear the brood of the invader.

**Stingless Bees (Meliponidae).**—These bees form a large group of mainly tropical distribution in the Old World as well as the New. In pre-Columbian days, before the introduction of sugarcane and before the establishment in the Western Hemisphere of the Old World honeybee, the stingless bees were the main reliance of those craving sweets. Columbus made acquaintance with the honey of these bees when during his first voyage he landed in Cuba; in neighboring Yucatan to this day there are flourishing apiaries of *Melipona beecheii.*

The sting of these bees is atrophied and nonfunctional but they have other means of defense. Some resort to biting. *Trigona* (*Oxytrigona*) emits a caustic fluid that is highly irritating—a form of chemical warfare long antedating such warfare by man. What often makes stingless bees annoying to human beings is their propensity to penetrate the hair. In Brazil they are called *torce cabellos* (hair twisters) in consequence. A name applied in Brazil to some of the tiny bees of *Trigona* (*Hypotrigona*) is *lambe olhos* (eye lickers) because of their habit of lapping moisture from the eye. Some stingless bees render powerless insect enemies that intrude in the nest by daubing them with sticky material—perhaps honey—until they are glued to death. This, curiously enough, is a method of warfare practiced also by a bumblebee (*Bombus fervidus*).

Stingless bees stock the brood cells with food and after an egg has been laid seal the cell after the manner of the solitary bees instead of engaging in progressive feeding of the larva as do the honeybees and bumblebees. Some stingless bees arrange their brood cells in irregular clusters often without orientation and separate these cells by minute intervening pillars of wax. The vast majority, however, arrange the cells in combs. These combs usually lie horizontally one above the other, not vertically as in the case of the honeybee, and the comb consists of a single layer of cells facing upward instead of a double row of cells placed base to base as in colonies of *Apis mellifica.* Honey and pollen are stored by stingless bees not in the cells of a comb but in relatively large pots. Earthen materials, dung, resin, leaf particles, and the like are used in nest-building besides the wax the bees secrete. Some species are ground-nesting, others arboreal. Sometimes the nests are exposed but more often concealed in hollows, frequently with a projecting tube, spout, or trumpet-shaped formation advertising the presence of the nest. Some species erect their structures within the nests of termites. Others occupy the nests of ants; nests of *Atta sexdens* are particularly favored. A few instances are recorded of the use of birds' nests as places of abode.

Edouard Drory, who in the 1870's tried to acclimatize stingless bees in Bordeaux, asserted that the male not only produced wax like the worker but also performed other tasks. These claims require verification notwithstanding the conscientious source from which they come. Throughout the Apoidea the role of the male tends to be limited to the fertilization of the female.

**The Honeybee (Apis mellifica).**—Man's interest in the honeybee and its products is an ancient one. A rock painting in the Cueva de la Araña (Spider Cave) near Valencia, Spain, dating back to Paleolithic times, shows a honey-gatherer climbing to a wild hive while the bees fly about menacingly.

FIG. 8.—Rock painting at the Araña (Spider) Cave, northwest of Bicorp, Valencia, Spain, showing an individual of the Stone Age gathering honey from a well-defended hive. About half actual size.

A relief in the Temple of the Sun, built about 2600 B.C., indicates that at that remote date beekeeping was practiced by the Egyptians. Techniques of apiculture which are sometimes thought of as modern—for instance, the transfer of hives from one region to another to take advantage of the nectar flow—were known in the Nile region as long ago as the 3d century B.C.

*Apis mellifica* has been introduced to many regions of the Western Hemisphere but originally it was a stranger to that half of the globe. It reached New England through the agency of man in the first part of the 17th century.

Several members of the genus *Apis* occur in the Indo-Malayan region. In addition to *Apis indica,* very closely allied to *mellifica,* there are the giant honeybee (*Apis dorsata*) and the dwarf honeybee (*Apis florea*). In the huge semicircular comb of *dorsata,* sometimes three or four feet in diameter and suspended usually from the branch of a tree, the brood cells are of one size. This uniformity accords with the condition in nests of the stingless bee genus *Melipona.* On the other hand *florea* builds, like *mellifica,* brood cells of three different kinds, dependent on the sex and prospective caste of the occupant.

The honeybee queen mates in flight. A single copulation usually enables the queen to lay fertile eggs throughout her subsequent life of several years. Her egg-laying capacity is impressive, varying from a few eggs daily in early spring and late fall in the northern part of her range, to as many as 1,500 to 2,000 per day at the peak of oviposition. Under special conditions even up to 5,000 eggs a day may be laid. Unfertilized eggs give rise to males.

All larvae are nourished for the first two or three days with royal jelly, probably a secretion of the lateral pharyngeal glands of the worker. At the end of this period honey and pollen are substituted as the diet of the prospective workers and drones, but royal jelly continues to be the food of a larva reared to be a queen. This difference of diet rather than any difference in the

fertilized egg apparently causes one individual to develop into a worker and another to emerge as a queen. Including the egg stage the preadult life of a worker, queen, and male is respectively 21 days, 16 days, and 24 days. The adult life of a worker in the period of active nectar flow is about four to six weeks; during the much more static winter conditions it is six months or more.

FIG. 9.—Fragment of a comb of *Apis mellifica*, with worker cells (some of them capped, others open) and below a pendant royal cell. Natural size.

Drones are tolerated in the hive until the nectar flow begins sharply to dwindle. Then there takes place what is often referred to as the slaughter of the drones. It usually represents a forcible ejection of these indolent members from the hive and a frustration of their subsequent efforts to re-enter. As the drones are largely dependent on the workers for food, exclusion from the parental home is the equivalent of starvation and death.

At the height of its development a *mellifica* colony rarely exceeds 70,000 bees. New hives are established by swarming. The old queen departs with the swarm, and her successor in the parental hive (provided there is no afterswarm) is usually the first of the royal daughters to emerge after the exodus of the swarm. To eliminate rivals this princess often slays her royal sisters while they are still imprisoned in their cells, dragging them forth and stinging them.

Through painstaking experiments performed by Karl von Frisch and later supplemented by A. Kühn it has been established that red and black are indistinguishable to honeybees, that they confuse yellow with orange and green, and blue with violet. Blue-green they recognize as distinct from blue and yellow. Finally they see ultraviolet, which is invisible to man.

Von Frisch also established the fact that a foraging bee on returning to the hive after the discovery of a promising food supply engages in two types of "dances." A round dance is performed when the supply is near but, when it is distant 100 meters or more, the bee executes a wagging dance (so designated because the abdomen is moved rapidly from side to side). The distance to the food supply bears a rather close relationship to the number of turns in the wagging dance made within a given time limit; the dance slows down with the increase of the distance. The direction in which the food supply lies is seemingly indicated by the direction of the so-called straight part of the wagging dance: if upward, the supply lies in the direction of the sun; if downward, then away from the sun. In response to these dances and aided by the floral scent adhering to the body of the dancing forager or to the droplet of nectar regurgitated from her honey-stomach, the bees fly forth and quickly locate the source of supply. Finally von Frisch has confirmed that honeybees are able to orient themselves by the polarization of sky light.

Interesting as are the discoveries made thus far regarding bees, it is safe to predict that much of a rewarding character still awaits the enterprising student of their ways.

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**BEE BIRDS,** birds reputed to devour bees, especially the honeybee. Not many birds have this habit, the bees being protected against most birds by their stings. A few flycatching birds, however, have learned how to avoid being stung, and catch not only bees but wasps, take them to a perch and beat them, so as to kill them, and probably get rid of the sting before swallowing them. Notable among these are the European and African bee eaters (q.v.). The American kingbirds (q.v.) also catch bees, but not as frequently as is popularly supposed, and are known in the Southern states as bee martins.

**BEE EATER,** a small, richly plumaged and graceful bird of southern Europe and northern Africa, whose food consists almost wholly of bees and wasps, and which haunts the neighborhood of the hives of honeybees and devours these useful insects in great numbers. The bee eaters are related to the kingfishers, and, like them, dig deep nesting-holes in earthen banks, and lay pure white eggs.

**BEE-KEEPING.** Few persons who see the little boxes of honey in the market realize the importance and extent of the bee-keeping industry of this country. According to the United States Department of Agriculture, over 200,000,000 pounds of honey are produced annually. When it is remembered that California alone, in a good year, can produce 500 carloads of honey, and that a good many of the other states produce from 50 to 100 carloads, one can form some idea of the commercial possibilities wrapped up in so small an insect as the bee.

The honey resources of the great West are very largely dependent on alfalfa, sweet clover,

orange and mountain sage; in the North Central and Eastern states, white, alsike, the new Ladino, and sweet clover; in the South and West, orange, tupelo, palmetto, cats-claw, mesquite, and guajilla.

Left to right: worker; queen bee; drone.

Most authorities agree that the honeybees' chief value lies in their ability to cross-pollinate fruit and legume blossoms, and thus largely increase the production of fruit and seed. Bees are responsible for 80-85 per cent of all crop pollination performed by insects. With the increased use of insecticides and more intensive cultivation of the land, many wild insects have been destroyed in recent years, leaving the important task of pollination more and more to the honeybee.

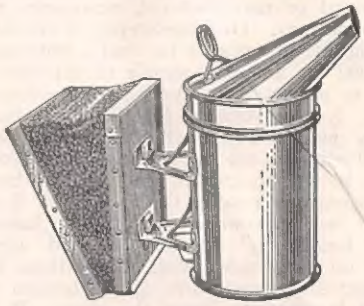
To assist in pollination and to increase the number of colonies, bees are shipped by the pound from the South. In 1948 more than a million pounds of bees were shipped in two- and three-pound cages without combs.

There are several species of bees—*Apis dorsata,* or the giant bee of India and the Philippines; *A. indica,* of India; *A. florea,* and *A. mellifica.* From a commercial standpoint, the last mentioned is the most important. It comprises the black bee of this country; the Italian bee from the southern part of Italy; the Syrian bee of Palestine; the Cyprian, from the island of Cyprus; the Carniolan, from Austria, and the Caucasian from the Caucasus Mountains. But the most important of all these varieties is the Italian bee. They are the most industrious and the gentlest. They, together with the black bees and their crosses, incorrectly termed "hybrids," are used most extensively in the United States—in fact, throughout much of the civilized world.

Bee on clover.

**Three Kinds of Hive Bees.**—There are three kinds of bees in the hive; namely, the workers, or undeveloped females; the queen, a fully developed female; and the drone or the male bee. The queen lays all the eggs of the hive and may lay as many as 2,000 in a day. Notwithstanding there may be from 10,000 to 100,000 bees in a single colony, the queen will be the mother of the whole colony. The drones are incapable of gathering honey, and serve only one purpose—that of fertilizing or fecundating the young queens, which act takes place in the air. The workers gather all the honey and pollen, fill all the combs, and rear the young or baby bees. As soon as the mating season is over, the drones are allowed to starve.

**How to Handle Bees.**—There is a general impression that ordinary honeybees are vicious, ready to attack any one who comes near their hives. This is a great mistake. Under certain conditions, when their habits are known, they will permit one to tear their hives apart, rob them of their hard earnings—honey and the wax—without even offering to sting. But an inexperienced or awkward person may irritate them. To bring them into a state of subjection it is only necessary to blow smoke into the entrance and over the combs, at which time, if the motions about the hive are careful and deliberate, they will offer no attack. Smoke, when intelligently used, disarms opposition and puts the bees in a quiet state.



Bee-smoker.

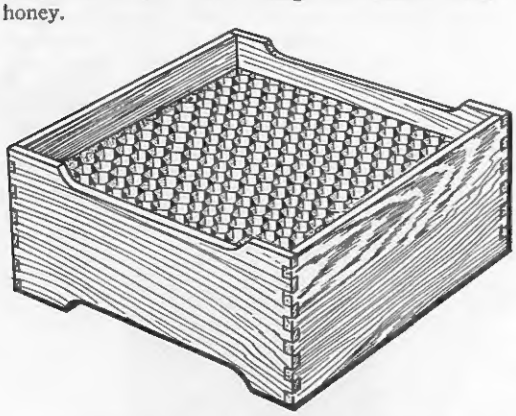
The bee-smoker is simply a small bellows attached to a cylindrical stove having a nozzle from which the smoke is blown. Besides the bee-smoker, the bee-keeper generally uses a bee-veil made of wire cloth. Gloves are sometimes used by timid persons or beginners, but as a general thing all work with the bees is performed with bare hands. Stings are, of course, occasionally received but beyond a sharp, momentary pain, no permanent effect will be felt after the first season for the bee-keeper very soon becomes immune so that no swelling takes place.

Bee-veil.

**Marketable Products of the Hive.**—These are beeswax, comb and extracted honey. Bees-

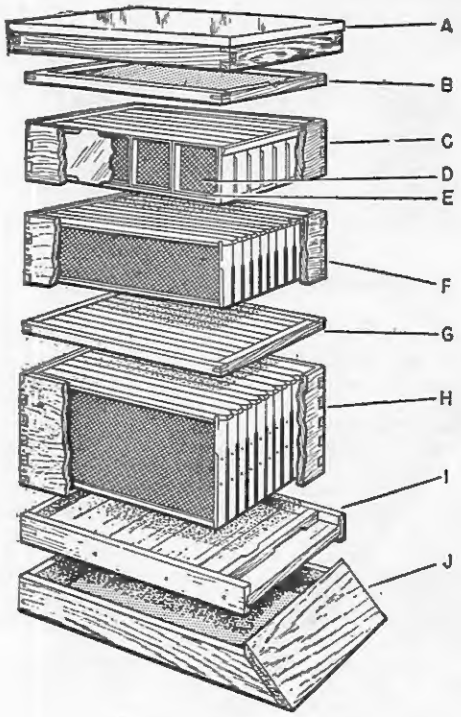
wax, which is secreted by the bees and used by them for building their combs, is an important commercial product and commands a good price in the United States. Three to five million pounds are produced there annually. This wax is used for waterproofing, for sacramental candles, and in cosmetics. Frequently there are combs to be melted up, and it pays to take care even of scraps of comb and the cappings taken off in extracting. A common method of taking out the wax is to melt the combs in a glass-covered pan heated by the sun. Various wax presses are on the market, but if much wax is produced, it is advisable that the bee-keeper make a careful study of the methods of wax extraction as usually there is much wax wasted.

**Comb Honey Production.**—Comb honey is usually put up in little square boxes, of which several million are made and used in the United States annually. The honey in these boxes retails from 30 cents to 70 cents. Extracted honey is in the liquid form, thrown from the combs by means of centrifugal force in a honey extractor, hence the name. Honey in the comb cannot be adulterated or manufactured, newspaper reports to the contrary. One bee-keeper of considerable standing and prominence has had a standing offer of $1,000 for a single sample of artificial comb honey so perfect as to deceive the ordinary consumer. Notwithstanding that this offer has been broadly published over the United States for over 50 years, no one has ever claimed the reward. It may be well to explain that a partial basis for these newspaper reports lies in the fact that bee-keepers use a commercial product known as "comb foundation" which is sheeted wax embossed on both sides with indentations having the exact shape and form of the bottom of the cells of honeycomb—hence the name. It is put into the hive where the bees draw it out into comb. This is as far as the skill of man can go; hence there is no such thing as artificial comb honey.



Section containing full sheet of comb foundation.

Producing comb honey requires considerable skill. Hives and supers are so arranged that the little boxes containing strips of comb foundation shall be accessible to the bees where they can build the foundation into comb, fill the cells with honey and seal them over. When the bees are busily at work in the fields and the combs are beginning to whiten and to be bulged with honey in what is called the brood nest, the honey boxes are put in the upper part of the hive. These are allowed to remain on during the height of the honey flow until they are filled and capped over, when they are removed and others put in their place.




Bee hive for comb honey

*A*—metal clad cover, telescopes over the supers below. *B*—inner cover, helps insulate bees from heat and cold and adds to convenience in handling bees. *C*—section super, for comb honey. In its surplus honey is stored in individual section boxes. *D*—thin super, beeswax comb foundation. *E*—comb section box. *F*—shallow super, with frames for storage of honey. There may be several of these to a hive. Surplus honey can be extracted from the combs or chunk honey may be cut out of the combs. *G*—excluder, placed over the deep super to keep the queen in the brood nest. *H*—deep super, with frames and beeswax comb foundation. This is used for the brood nest when next to the bottom of the hive or for surplus honey if another deep super is placed on above this. *I*—bottom board, equipped with an entrance-contracting cleat that can be changed as conditions warrant. *J*—hive stand, extra equipment that may be used to keep the hive from the ground.

**Extracted Honey Production.**—The business of producing extracted (or liquid) honey requires almost the same intelligent care and attention. Instead of section boxes, however, an extra set of combs is put in the upper story, the same being placed above the lower or brood part of the hive. When these are filled with honey and capped over, they are removed from the hive by first shaking the bees off, or by what is known as a bee-escape board, taken to the extracting house and extracted. The thin film of wax covering the comb is shaved off with a knife specially designed for the purpose. After the combs are uncapped, they are put in the honey extractor and revolved at a high rate of speed. The honey flies out of the comb by centrifugal force against the sides of the extractor, when the combs are reversed, exposing the other surfaces which are emptied in a like manner. They are next returned to the hive to be filled by the bees, when the process may be repeated as long as the season lasts.